ENGAGING THE WILDFIRE APPLICATIONS COMMUNITY WITH SAR

NISAR Applications Team: E. Natasha Stavros*, Susan Owen*, Cathleen Jones*

Co-Authors: Marco Lavalle*, Sang-Ho Yun*, Sassan Saatchi*, Josef Kellndorfer (Earth Big Data), Paul Rosen*

* Jet Propulsion Laboratory, California Institute of Technology

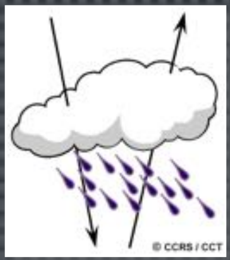
OBJECTIVES

- Increase SAR literacy in the context of wildfire management and the upcoming NISAR mission
- Identify the best venue and approach for reaching the wildfire community
  - Build partnerships and collaborations to identify and develop needed information products
  - Identify gaps in knowledge of highest value to the community with focused and detailed discussions of what the SAR data needs are including:
  - Assess the feasibility of NISAR to meet the top priorities for the application area
  - Identify high priority Applications for NISAR to focus efforts

Outline

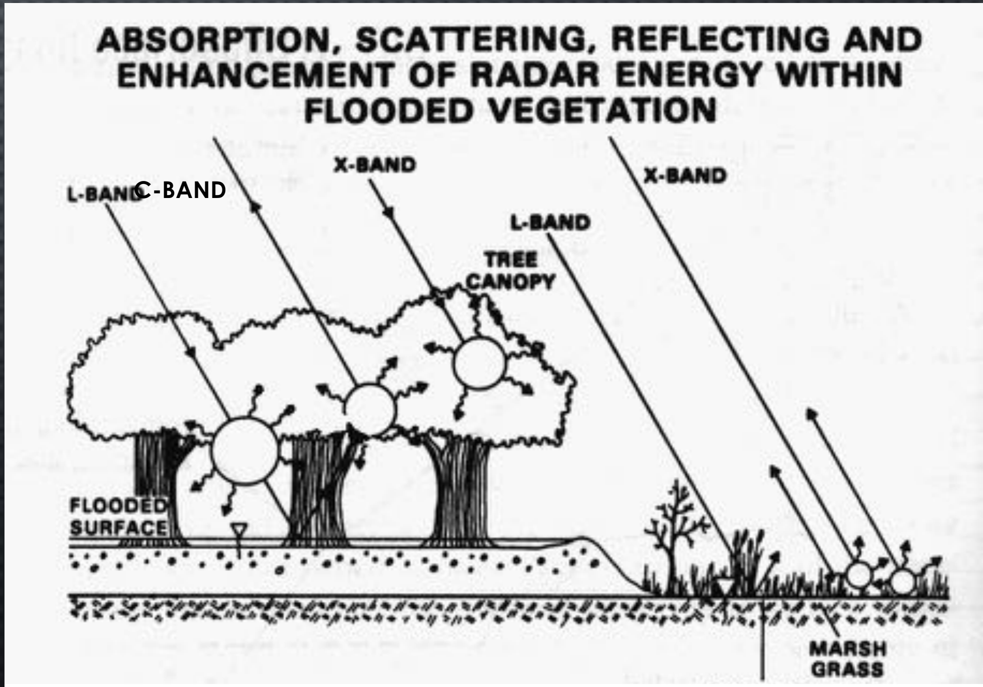
- Introduction to SAR (15 min)
- Applications for wildfire management (15 min)
- NISAR flight project and Applications Plan Overview (10 min)
- Table Top Exercise (45 min)
- Concluding Thoughts (5 min)

WHY SAR?



- Cloud penetration
  - Key for monitoring tropical forests and Arctic/boreal
  - Key for annual observations
- Nighttime observations
  - Monitor poles during winter
- Sensitivity to forest vertical structure
- Sensitivity to flooding and soil moisture

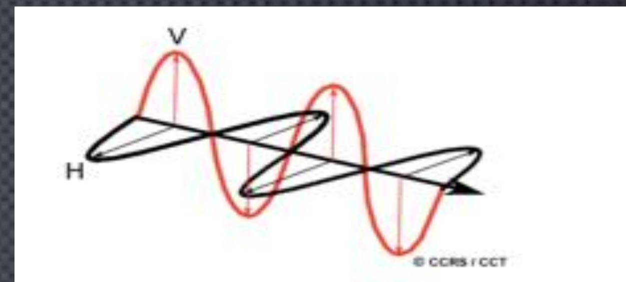
Slide Courtesy of: Josef Kellndorfer

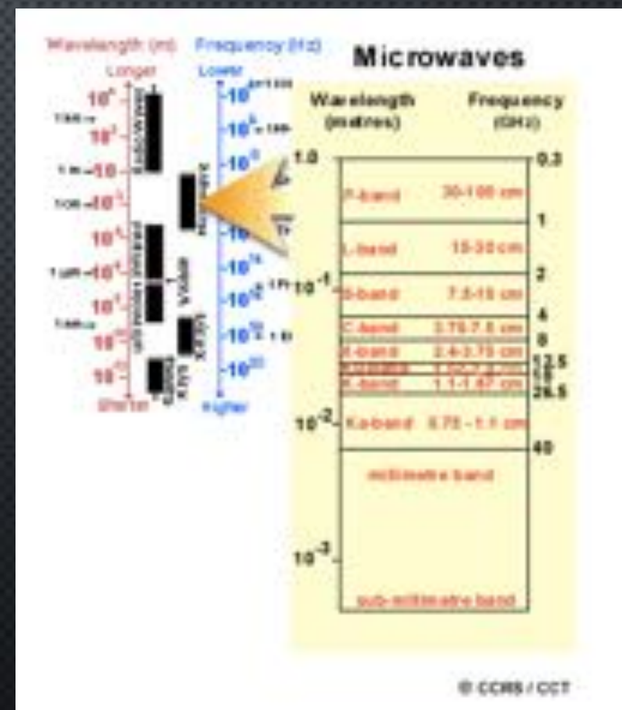


From: Manual of Remote Sensing Third Edition, Vol 2

THE BASICS

- Figures from this slide and fantastic educational resource: Canada Centre for Mapping and Earth Observation (formerly Canada Centre for Remote Sensing), Natural Resources Canada
- Electromagnetic Waves emitted from a source, propagate in horizontal (H) and Vertical (V) with field strength and phase in each direction.
- Radar uses microwaves
- 4 techniques:
  1. Simple backscatter
  2. Coherent polarimetry
  3. Polarimetric interferometry (InSAR/PolInSAR)
  4. Tomography





(http://www.nrcan.gc.ca/earth-sciences/geomatics/satellite-imagery-air-photos/satellite-imagery-products/educational-resources/)

(1) Simple Radar Backscatter

- Radar transmits alternatively H and V polarized waves
- Radar receives simultaneously H and V
- Amplitude of backscattered energy (no phase)

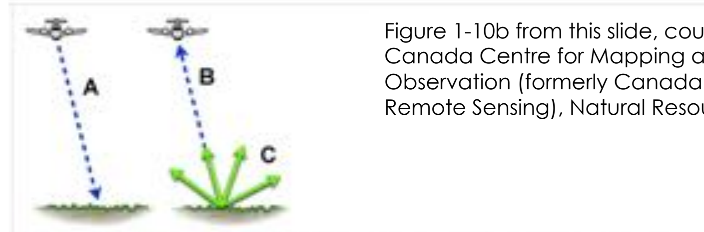
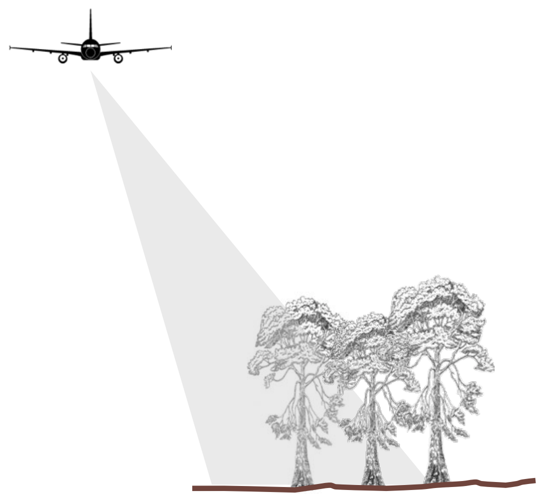
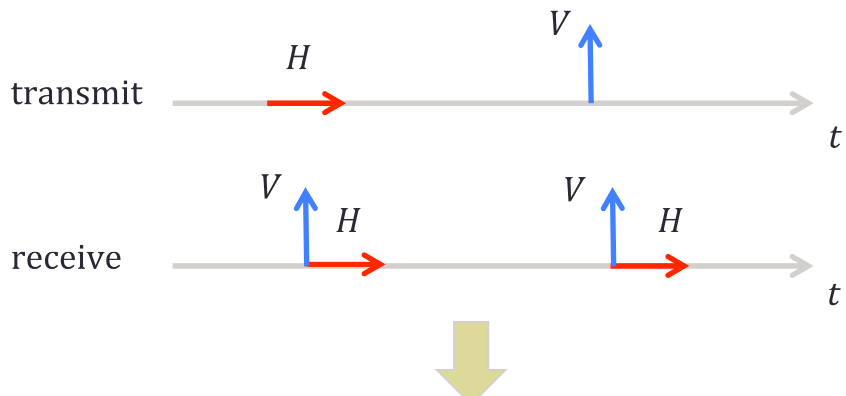


Figure 1-10b: Illustrating backscatter - only a small part of the scattered energy (C) is received back at the radar antenna (B)

Figure 1-10b from this slide, courtesy of: Canada Centre for Mapping and Earth Observation (formerly Canada Centre for Remote Sensing), Natural Resources Canada

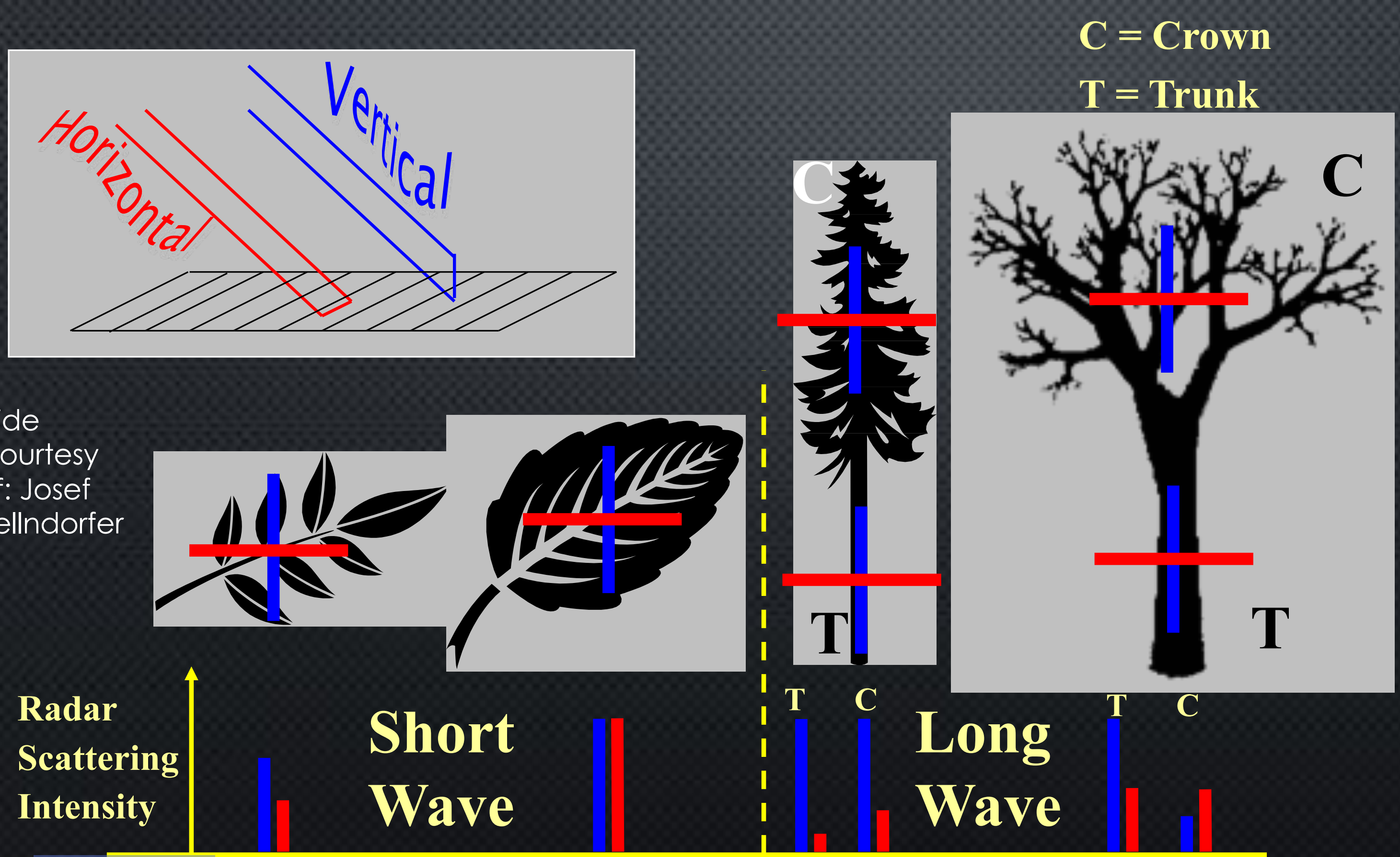




$$\begin{pmatrix} E_H^s \\ E_V^s \end{pmatrix} = \frac{e^{-j\beta r}}{r} \underbrace{\begin{pmatrix} S_{HH} & S_{HV} \\ S_{VH} & S_{VV} \end{pmatrix}}_{\text{scattering matrix [S]}} \begin{pmatrix} E_H^i \\ E_V^i \end{pmatrix}$$

Slide Courtesy of: Marco Lavalle (JPL)

REVIEW THE ROLE OF POLARIZATION



Slide Courtesy of: Josef Kellndorfer

- Polarization – alignment and regularity of EM field components of the wave in a plane perpendicular to the direction of propagation
- Noise – no recognizable frequency and amplitude
- EM Wave with no random component = fully polarized
- "backscatter" is energy (amplitude) that gets reflected back

(2) Coherent Radar Polarimetry

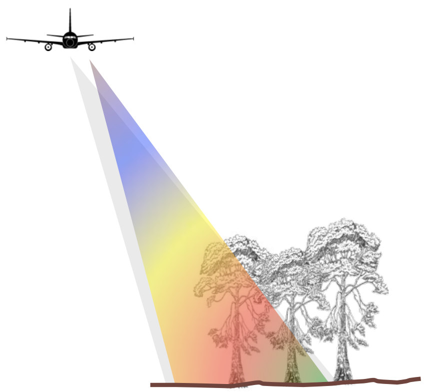
- Both amplitude and phase are retained and processed
- "Measurement" is the 3 × 3 covariance matrix
- Depolarization and scattering mechanisms to study ecosystems

scattering matrix

$$\begin{pmatrix} E^s_H \\ E^s_V \end{pmatrix} = \frac{e^{-j\beta r}}{r} \begin{pmatrix} S_{HH} & S_{HV} \\ S_{VH} & S_{VV} \end{pmatrix} \begin{pmatrix} E^i_H \\ E^i_V \end{pmatrix}$$

$$k = \begin{pmatrix} S_{HH} \\ \sqrt{2}S_{HV} \\ S_{VV} \end{pmatrix}$$

scattering vector

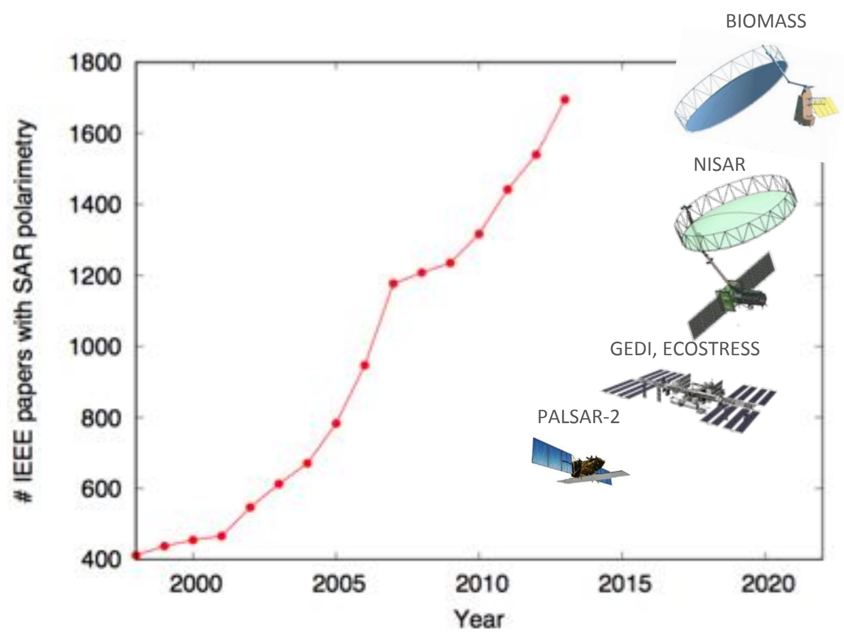


$$[C] = \frac{1}{N}\sum_i^N k_i k_i^H = \begin{pmatrix} \langle |S_{HH}|^2 \rangle & \sqrt{2}\langle S_{HH}S^*_{HV} \rangle & \langle S_{HH}S^*_{VV} \rangle \\ \sqrt{2}\langle S_{HV}S^*_{HH} \rangle & 2\langle |S_{HV}|^2 \rangle & \sqrt{2}\langle S_{HV}S^*_{VV} \rangle \\ \langle S_{VV}S^*_{HH} \rangle & \sqrt{2}\langle S_{VV}S^*_{HV} \rangle & \langle |S_{VV}|^2 \rangle \end{pmatrix}$$

complex covariance matrix

Slide Courtesy of:
Marco Lavalle (JPL)

(2) Coherent Radar Polarimetry



Slide Courtesy of:
Marco Lavalle (JPL)

(2) Coherent Radar Polarimetry

$$u_i = \begin{pmatrix} \cos\alpha_i \\ \sin\alpha_i \cos\beta_i e^{j\delta_i} \\ \sin\alpha_i \sin\beta_i e^{j\gamma_i} \end{pmatrix}$$

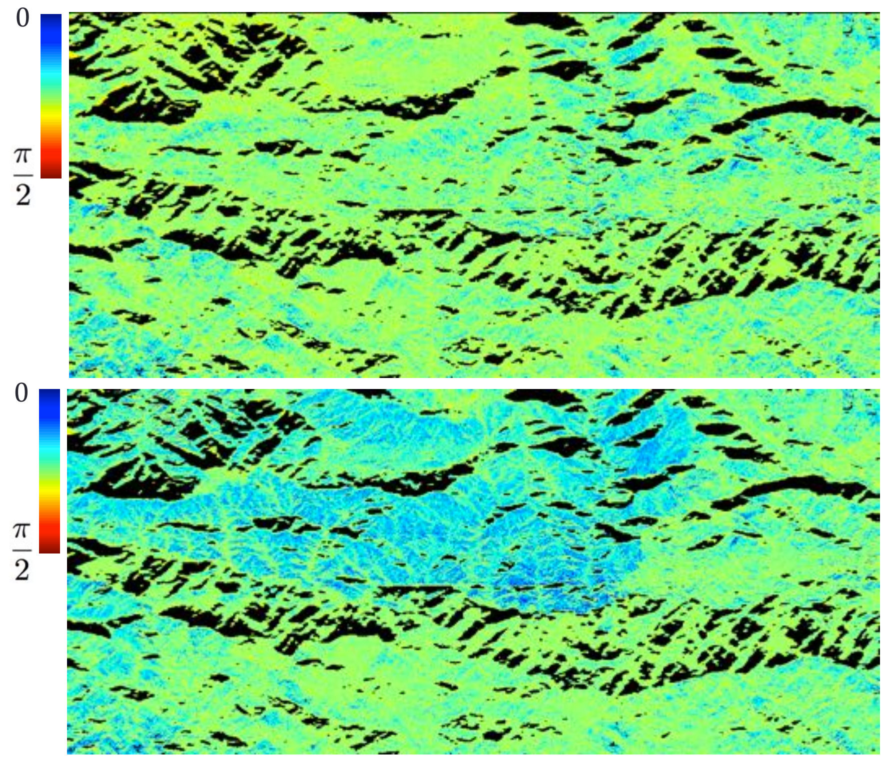
parameterized eigenvector

$$p_i = \frac{\lambda_i}{\sum_{q=1}^{3} \lambda_q}$$

eigenvalues

Alpha "scattering mechanism"

$$\alpha = \sum_{i=1}^{3} p_i \alpha_i \quad 0 \le \alpha \le \frac{\pi}{2}$$



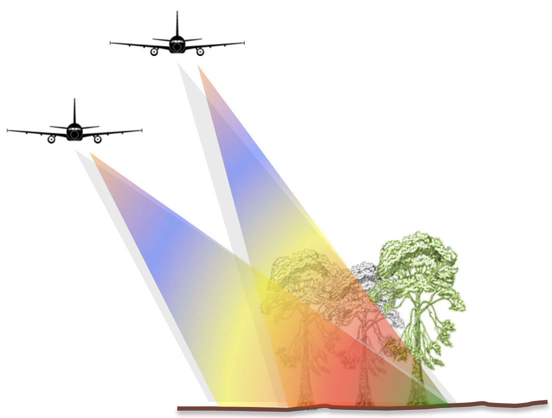
~ surface ~ volume ~ dihedral

$\alpha = 0$ $\alpha = \frac{\pi}{4}$ $\alpha = \frac{\pi}{2}$

Slide Courtesy of:
Marco Lavalle (JPL)

(3) Polarimetric Radar Interferometry

- polarimetry "sees" different forest components
- interferometry retrieves the 3D location of the component
- canopy height, vertical structure



$$\gamma = |\gamma| e^{j\varphi} = \frac{\langle s_1 s_2^* \rangle}{\sqrt{\langle s_1 s_1^* \rangle \langle s_2 s_2^* \rangle}}$$

PolInSAR coherence
(temporal and volumetric)

$$\gamma(w_1, w_2) = f(p_1, p_2, \ldots, p_n)$$

PolInSAR model

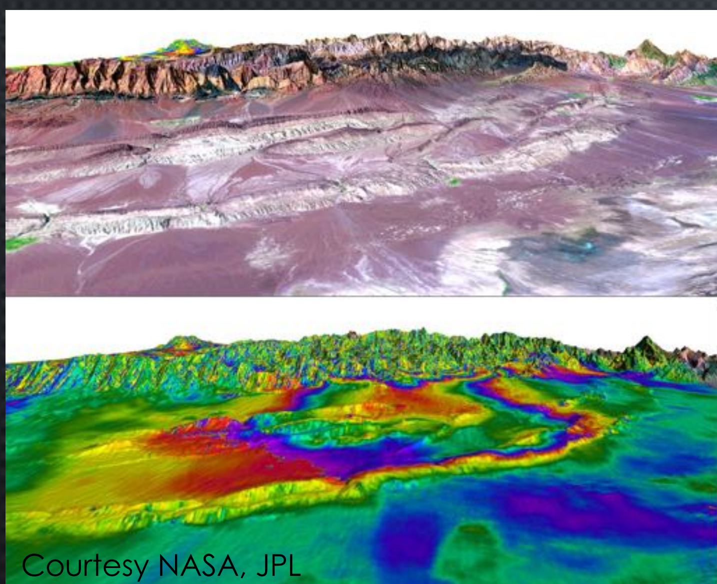
model parameters

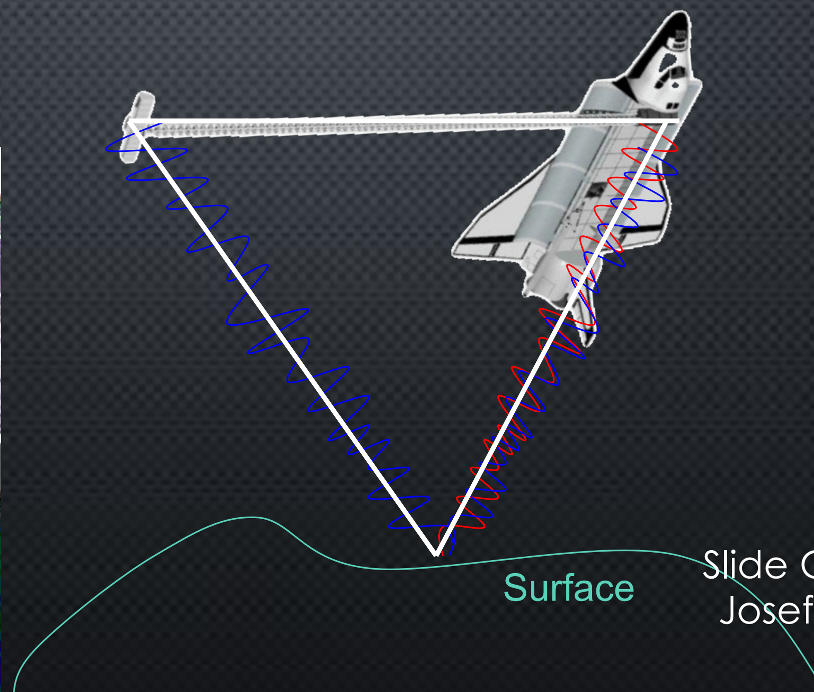
canopy height
wave extinction
ground topography
surface-to-volume ratio

Slide Courtesy of:
Marco Lavalle (JPL)

SAR INTERFEROMETRY: MEASURING HEIGHT

IT'S SIMPLE TRIGONOMETRY

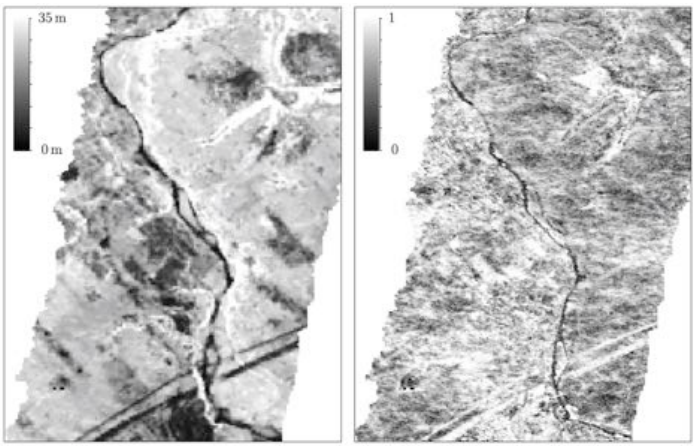

Courtesy NASA, JPL



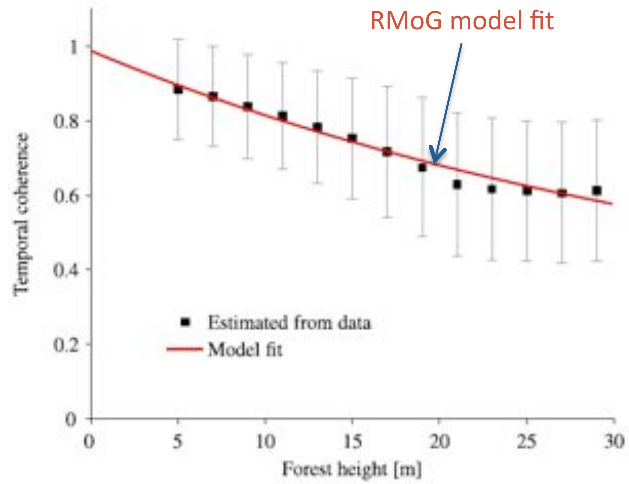
Slide Courtesy of:
Josef Kellndorfer

(3) Polarimetric Radar Interferometry

lidar canopy height (LVIS) HV radar coherence (UAVSAR)



JPL/UAVSAR L-band airborne radar
45 min temporal baseline
Laurentides, Quebec



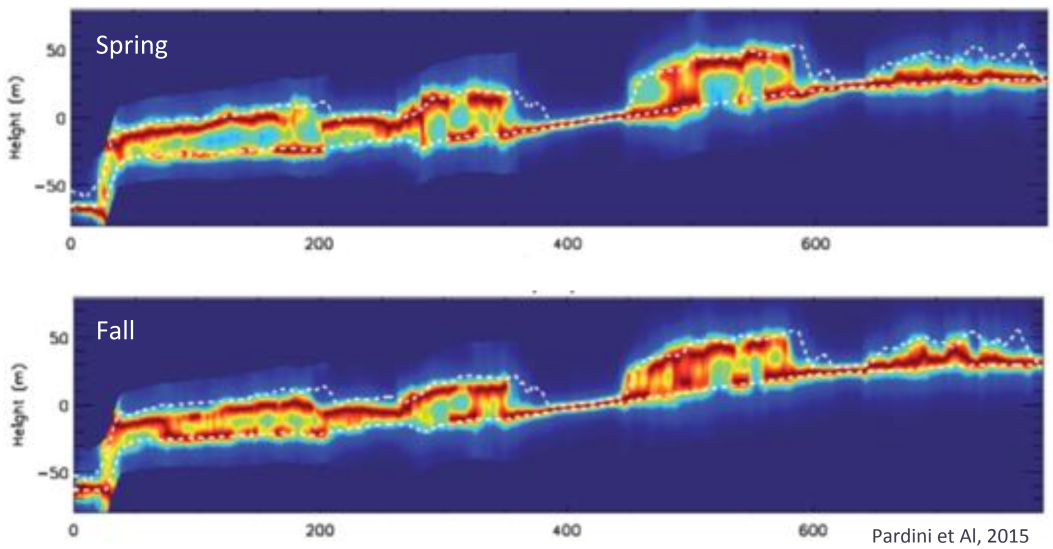
Slide Courtesy of:
Marco Lavalle (JPL)

Lavalle et Al., "A temporal decorrelation model for polarimetric radar interferometers", IEEE TGRS 2012.

Slide Courtesy of: Marco Lavalle (JPL)

(4) Radar Tomography

- Several (3+) repeated acquisitions over the same area
- Physical models and polarimetry are not needed
- Retrieval of 3D structure (layered backscattered coefficient)



Pardini et Al, 2015

APPLICATIONS FOR WILDFIRE MANAGEMENT

1. Change Detection and mapping
2. Moisture: Soil and Vegetation
3. Biomass

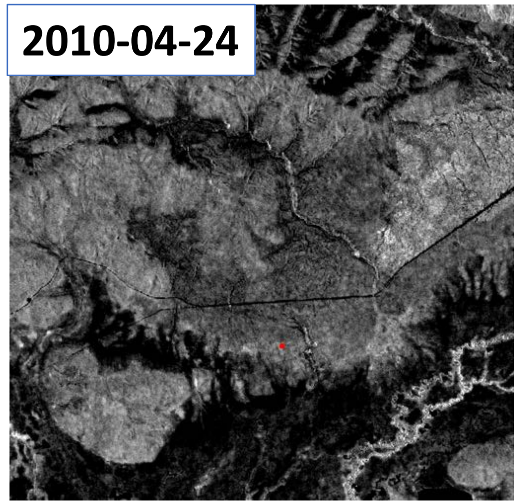
DETECTION AND MAPPING

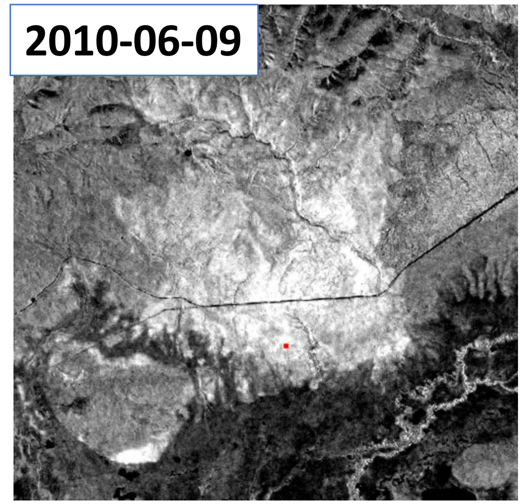
Slides Courtesy of: Josef Kellndorfer and Sang-ho Yun

Slide Courtesy of: Josef Kellndorfer (Earth Big Data)

ALOS LHH Time series

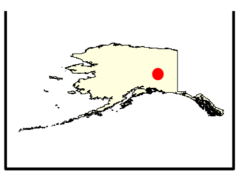
April 24th:	Before fire
June 6th:	11 days after fire starts
Sept. 9th:	Fire scar well identifiable



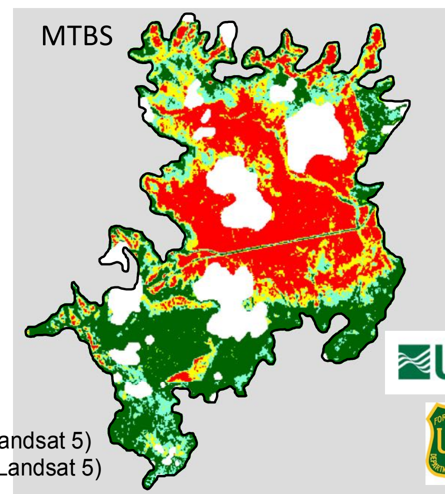


Acreage of Burn Severity

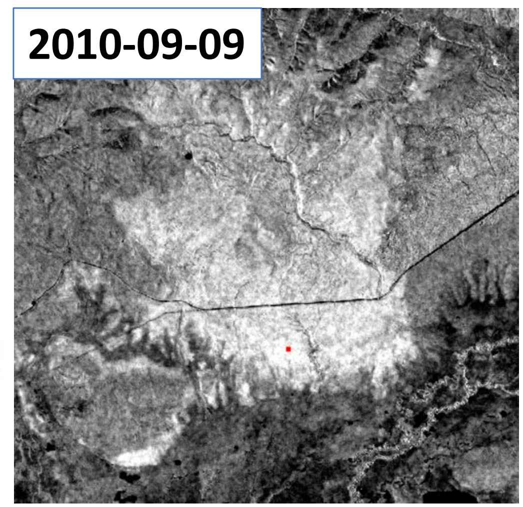
Burn Severity	Acres
Unburned to Low	6,035
Low	2,679
Moderate	2,787
High	5,509
Increased Greenness	45
Non-Processing Area Mask*	3,464
Total	**20,519**



Latitude: 64° 20' 16.8"
Longitude: -145° 45' 28.8"
Fire Ignition Date: May 26, 2010
Assessment Type: Extended
Pre-Fire Image Date: July 11, 2009 (Landsat 5)
Post-Fire Image Date: July 17, 2011 (Landsat 5)



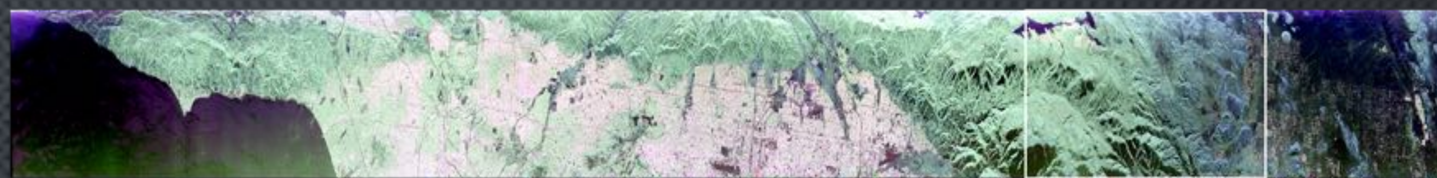
USGS



Slide Courtesy of: Sang-Ho Yun (JPL)

CHANGE DETECTION USING FREQUENT REPEAT VISITS

UVASAR ID: 26524

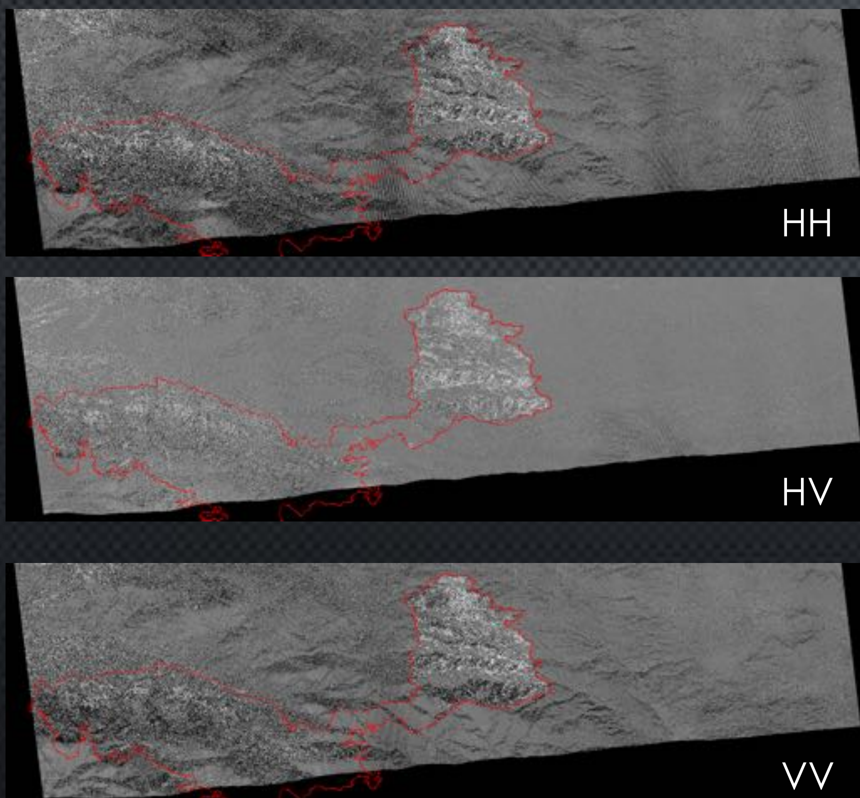


Index	Acquisition date
1	2009.04.23
2	2009.09.18
3	2010.03.03
4	2010.04.15
5	2010.10.14
6	2010.12.07
7	2011.07.08
8	2011.10.28
9	2012.04.27
10	2013.05.31
11	2014.01.17
12	2014.10.23
13	2015.01.08
14	2015.05.11
Lake Fire	
15	2015.06.29

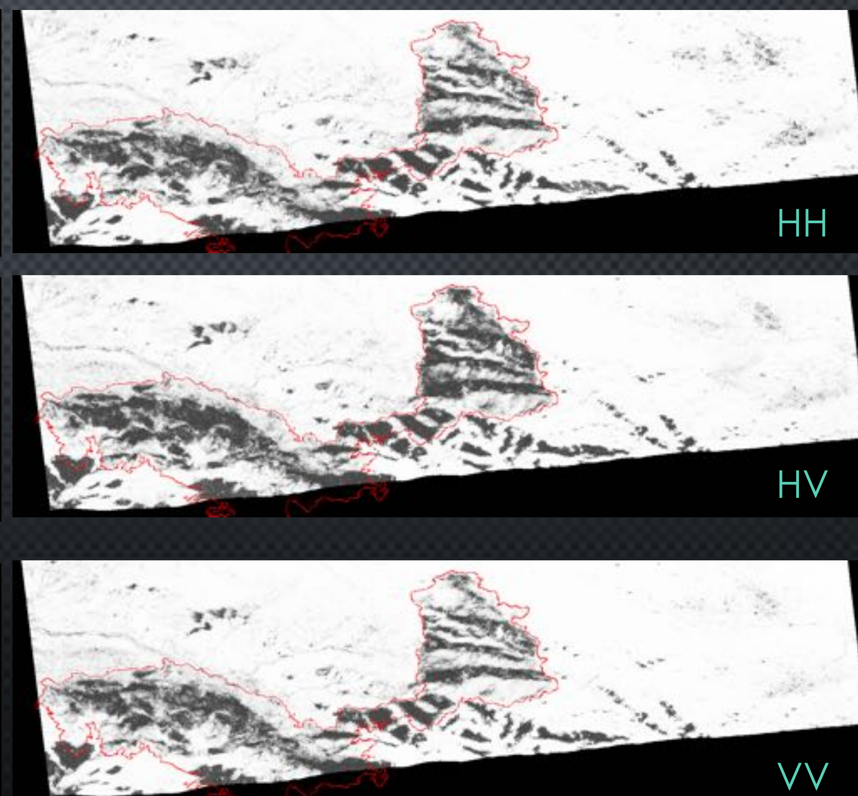
- Number of data : 15
  - before event : 14 & after event : 1
- All data is acquired using Full-Quad polarization
- Baseline : less than ~10 m
- No volumetric decorrelation
- Coherence is mainly determined by temporal decorrelation

Parameter	Value
Frequency	L-Band 1217.5 to 1297.5 MHz
Bandwidth	80 MHz
Resolution	1.67 m Range, 0.8 m Azimuth
Polarization	Full Quad-Polarization
ADC Bits	2,4,6,8,10 & 12 bit selectable BFPQ, 180Mhz
Waveform	Nominal Chirp/ Arbitrary Waveform
Antenna Aperture	0.5 m range /1.5 azimuth (electrical)
Azimuth Steering	Greater than ±20° (±45° goal)
Transmit Power	> 3.1 kW
Polarization Isolation	<-25 dB (<-30 dB goal)
Swath Width	> 23 km

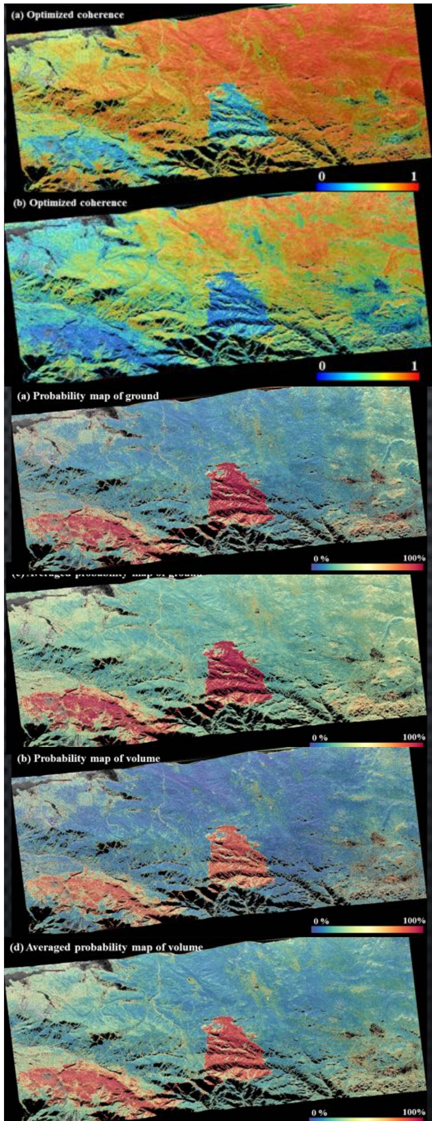
INCOHERENT CHANGE DETECTION (AMPLITUDE)



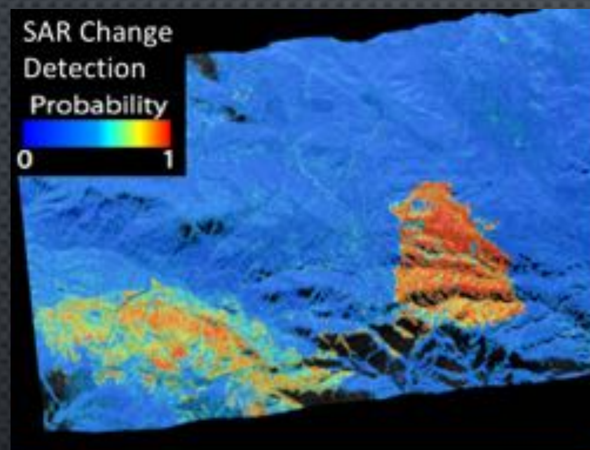
COHERENT CHANGE DETECTION (AMPLITUDE AND PHASE)

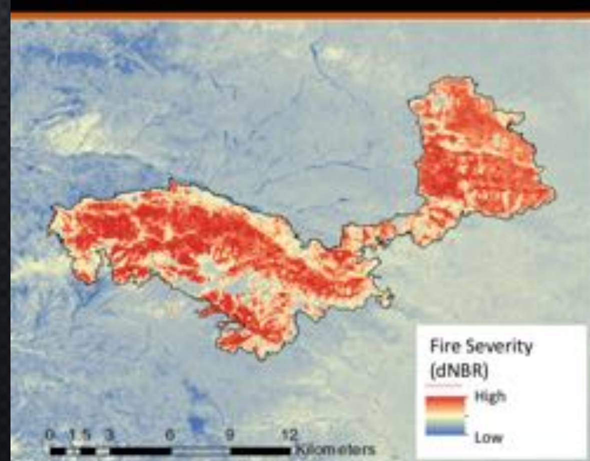


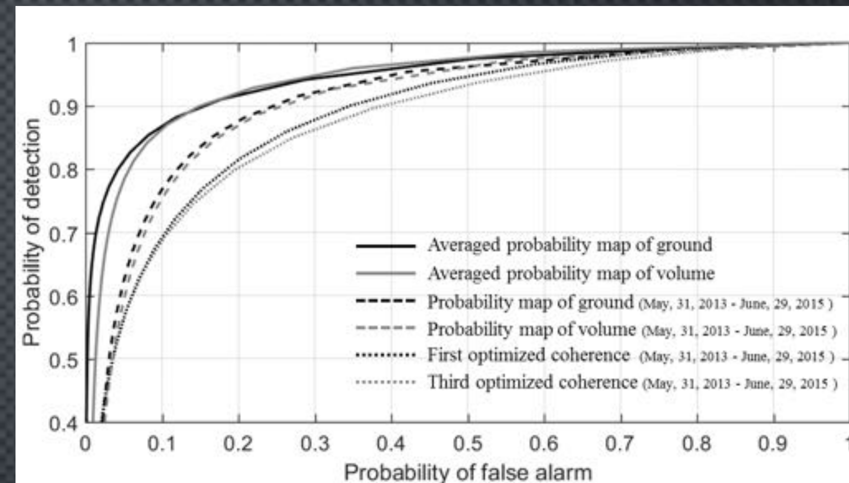
Slide Courtesy of: Sang-Ho Yun (JPL)



PERFORMANCE EVALUATIONS







Product	PFA @ PD=0.85	PD @ PFA=0.1
Coherence opt1	0.25	0.68
Coherence opt3	0.29	0.68
Individual Prob. of ground	0.14	0.77
Individual Prob. of volume	0.16	0.75
Averaged Prob. of ground	**0.07**	**0.87**
Averaged Prob. of volume	**0.08**	**0.86**

Slide Courtesy of: Sang-Ho Yun (JPL)

MOISTURE: SOIL AND VEGETATION

Slides Courtesy of:

Soil moisture estimation: ALOS-2 example

Polarimetric ALOS-2 SLCs

↓

Multilook and coherency matrix generation

↓

Separation of scattering mechanisms

↓

Soil [T] matrix elements

↓

Model-based inversion

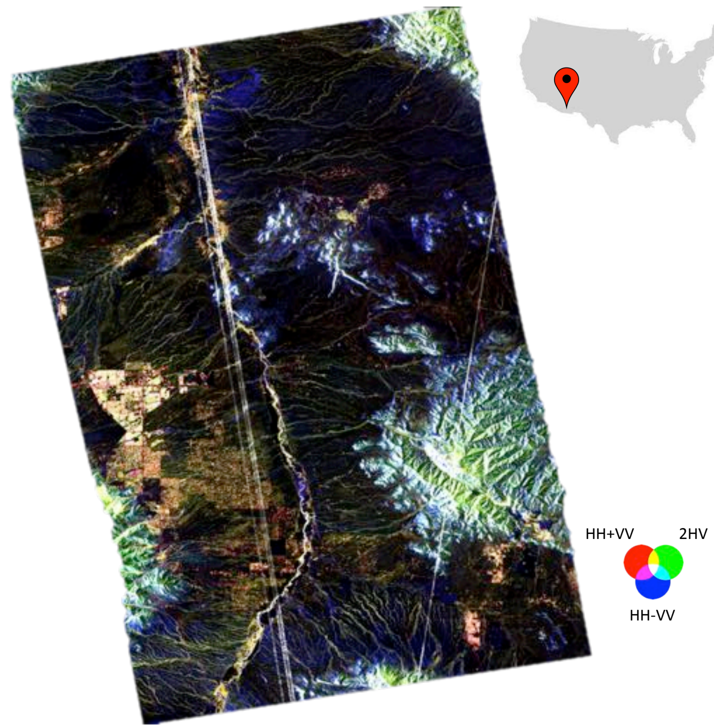
↓

Dielectric constant to soil moisture

↓

Soil moisture map

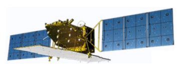
ALOS-2 + ICESat lidar data



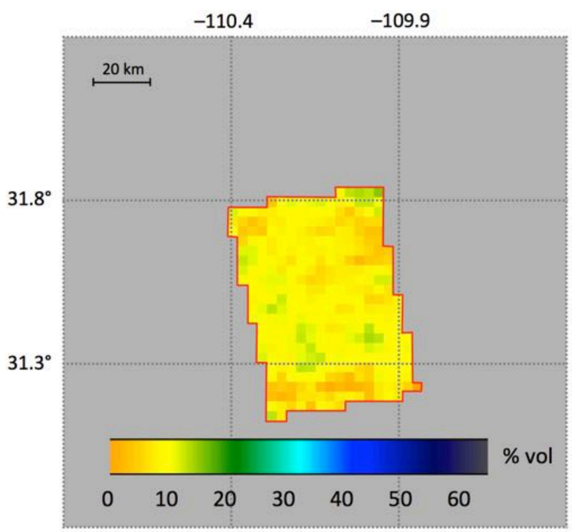
Slide Courtesy of: Marco Lavalle (JPL)

Soil moisture estimation: ALOS-2 example

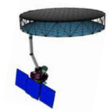
ALOS-2



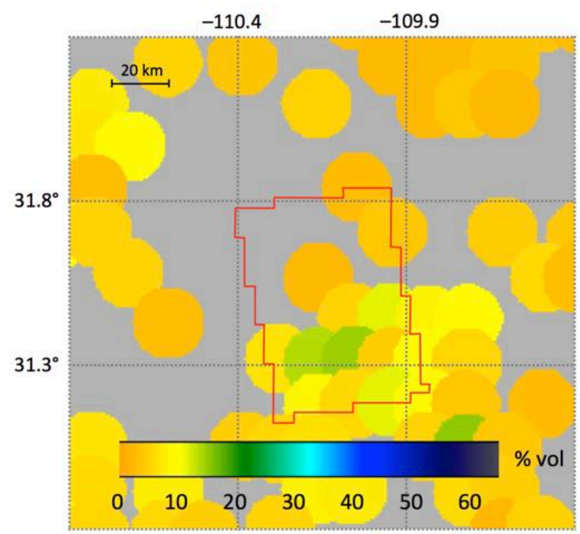
Acquisition date is 2015/03/07
Posting is 3.3 Km to match SMAP posting
Quad-polarimetric SAR data
Model-based soil moisture retrieval



SMAP



Acquisition date is 2015/04/25
Posting is 3 km after multilooking
1 dot = 1 pixel enlarged for display
Gaps are retrieval failures



Slide Courtesy of: Marco Lavalle (JPL)

BIOMASS

SLIDES COURTESY OF: SASSAN SAATCHI (JPL)

SAR can help measure carbon emissions and removals from deforestation, degradation, and regeneration by measuring vegetation biomass and monitoring changes

deforestation

degradation

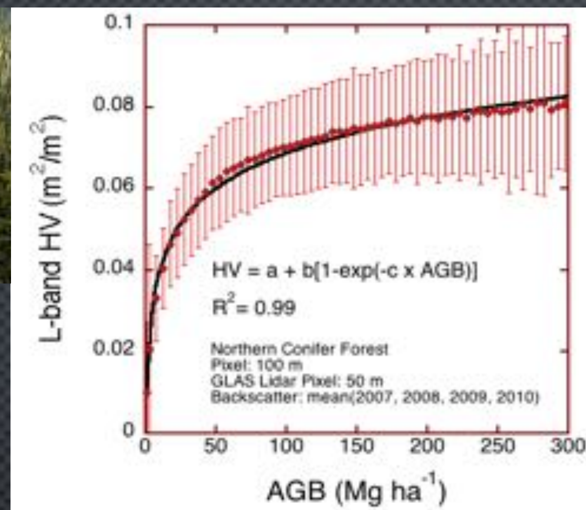
Regeneration

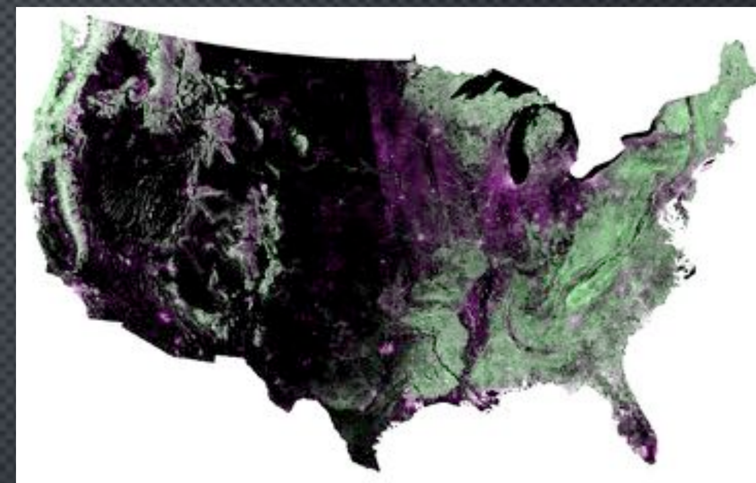
$$\Delta C = \sum \Delta A \cdot \boxed{B} \cdot E_{def} + \sum A \cdot \boxed{\Delta B} \cdot E_{\deg} + \sum A \cdot \boxed{\Delta B} \cdot R_{reg}$$

where A is the area of forest type, with biomass B, emission efficiency factor E, and removal efficiency R

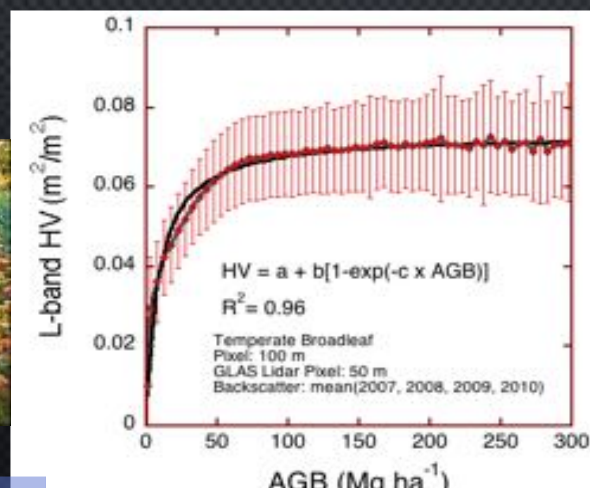
Slide Courtesy of: Sassan Saatchi (JPL)

MAPPING GLOBAL FOREST BIOMASS





L-band HH and HV (ALOS PALSAR)



Biomass Derived from L-band SAR & National Inventory

Slide Courtesy of: Sassan Saatchi (JPL)

NASA-ISRO SYNTHETIC APERTURE RADAR (NISAR) OVERVIEW AND APPLICATIONS PLAN OVERVIEW

SLIDES COURTESY OF: PAUL ROSEN AND NATASHA STAVROS

Slide Courtesy of: Paul Rosen(JPL)

NISAR MISSION OBJECTIVES

Relevant Scientific Objectives:

- Understand the dynamics of carbon storage and uptake in wooded, agricultural, wetland, and permafrost systems

Relevant Applications Objectives:

- Provide agricultural monitoring capability in support of food security objectives
- Apply NISAR's unique data set to explore the potentials for urgent response and hazard mitigation

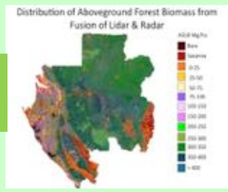
To be accomplished in partnership with the Indian Space Research Organisation (ISRO) through the joint development and operation of a space-borne, dual-frequency, polarimetric, synthetic aperture radar (SAR) satellite mission with repeat-pass interferometry capability

Slide Courtesy of: Paul Rosen(JPL)

NISAR MISSION CONCEPT OVERVIEW

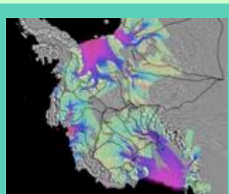
Mission Science

Ecosystem Structure



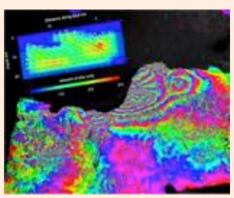
Biomass disturbance; effects of changing climate on habitats and CO_2

Cryosphere



Ice velocity, thickness; response of ice sheets to climate change and sea level rise

Solid Earth



Surface deformation; geo-hazards; water resource management

- Major partnership between US National Aeronautics and Space Administration (NASA) and Indian Space Research Organisation (ISRO)
- Baseline launch date: No earlier than 2021
- Dual frequency L- and S-band Synthetic Aperture Radar (SAR)
  - L-band SAR from NASA and S-band SAR from ISRO
- NASA 3.5 Gbps Ka-band telecom system to polar ground stations (> 24 Tbits/day downlink capability)
- Spacecraft: ISRO I3K with 1 Gbps telecom system
- Launch vehicle: ISRO Geosynchronous Satellite Launch Vehicle (GSLV) Mark-II (4-m fairing)
- 3 years science operations (5+ years consumables)
- All science data (L- and S-band) will be made available free and open, consistent with the long-standing NASA Earth Science open data policy

Slide Courtesy of: Paul Rosen(JPL)

NISAR CONCEPT SCIENCE OBSERVATION OVERVIEW

NISAR Characteristic:	Would Enable:
L-band (24 cm wavelength)	Low temporal decorrelation and foliage penetration
S-band (12 cm wavelength)	Sensitivity to light vegetation
SweepSAR technique with Imaging Swath >240 km	Global data collection
Polarimetry (Single/Dual/Quad)	Surface characterization and biomass estimation
12-day exact repeat	Rapid Sampling
3-10 meters mode-dependent SAR resolution	Small-scale observations
3 years since operations (5 years consumables)	Time-series analysis
Pointing control < 273 arcseconds	Deformation interferometry
Orbit control < 500 meters	Deformation interferometry
>30% observation duty cycle	Complete land/ice coverage
Left/Right pointing capability	Polar coverage, North and South
Noise Equivalent Sigma Zero ≤ -23 db	Surface characterization of smooth surfaces

NISAR Will Uniquely Capture the Earth in Motion

LEVEL 3 ECOSYSTEM PRODUCTS CURRENTLY BEING DEVELOPED FOR GLOBAL PRODUCTION AND RELEASED ANNUALLY

- BIOMASS ESTIMATION

  aboveground woody vegetation biomass annually at the hectare scale (1 ha) to an RMS accuracy of 20 Mg/ha for 80% of areas of biomass less than 100 Mg/ha.

- DISTURBANCE DETECTION

  global areas of vegetation disturbance at 1 hectare resolution annually for areas losing at least 50% canopy cover with a classification accuracy of 80%.

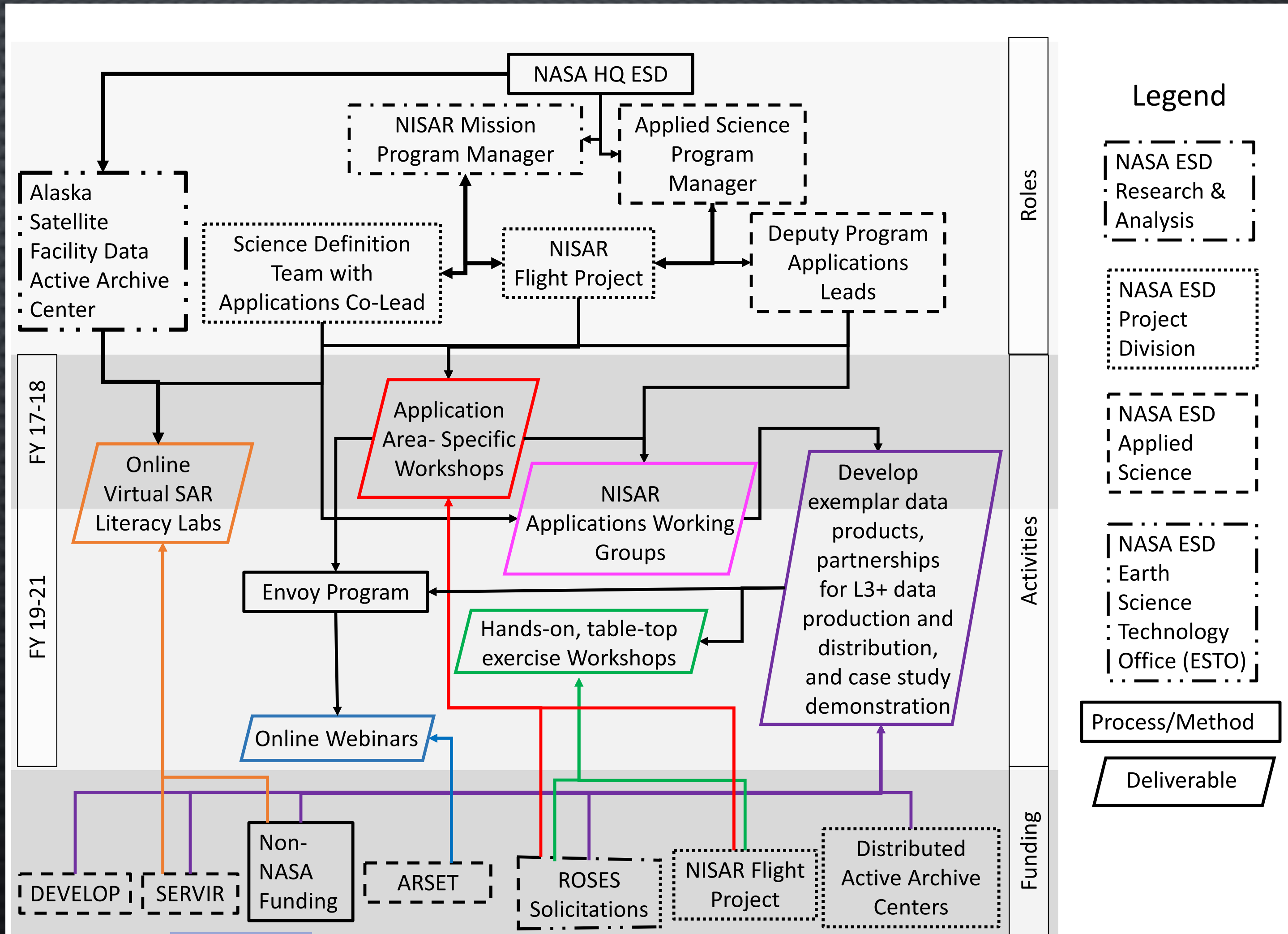
- AGRICULTURE CLASSIFICATION

  crop area at 1 hectare resolution every 3 months with a classification accuracy of 80%.

- WETLAND CLASSIFICATION

  inundation extent within inland and coastal wetlands areas at a resolution of 1 hectare every 12 days with a classification accuracy of 80%.

NISAR APPLICATIONS PLAN



Slide Courtesy of: Paul Rosen(JPL)

QUESTIONS?

Table Top Exercise

- 7 tables:
  - 2 tables: Biomass/forest height
  - 2 Tables: Veg/Soil moisture
  - 2 Tables: Detection and Mapping
  - 1 Table: Other (Conservation, etc.)
- Break into 3 groups to discuss (20 min) & report out (20 min):
  1. What agencies/organizations are the key players (i.e., who is the trusted source of information used in this arena? Is there a "Champion" we should be working with?)
  2. What are the current decision support systems employed?
  3. What are the information gaps in the current decision support systems?
  4. Can you see SAR helping to fill any of these information gaps? If so, what Information products would need to be developed (including specifications of frequency, latency, etc.)?
  5. What are the best ways to engage with the community who would most want this data (e.g., how do we garner trust and a collaborative relationship)?

RESOURCES

- NISAR Ecosystems Deputy Application Lead: Natasha.Stavros@jpl.nasa.gov
  - NISAR Applications Mailing List: Workshops, NISAR Status updates, etc.
  - SAR expert connections
  - DEVELOP -- 10 week feasibility studies to see how SAR can work for you
- 2 page informational on table
- Tutorials/Educational Resources
  - SAREdu
  - UNAVCO
  - Natural Resources Canada
  - ARSET

THINGS TO THINK ABOUT
FROM DAVID GREEN'S ASP DISASTERS PROGRAM

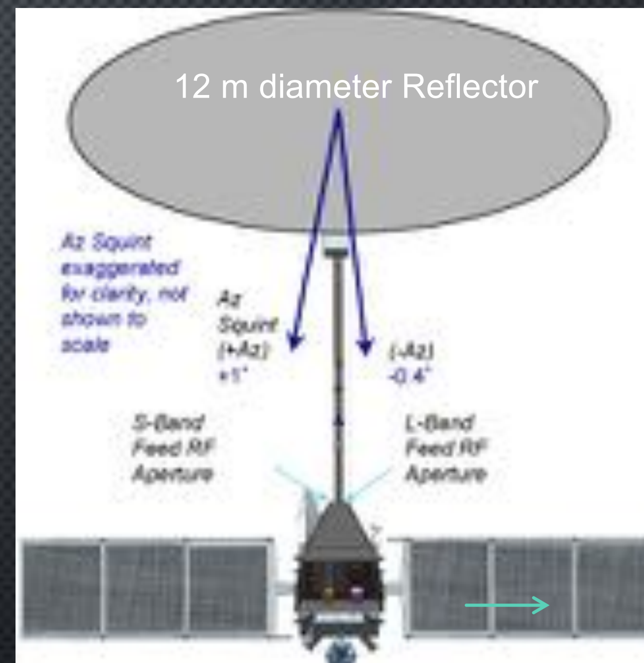
- 2017 ROSES DISASTER CALL (OUT IN MAY)
  - STRINGS:
    - COST-SHARING (MULTI-YEAR TAKE MORE BURDEN EACH YEAR)
    - ARL 4-9 EXCEPTIONS CAN BE MADE
    - MUST HAVE LETTER OF SUPPORT/CO-I/ACTIVE MEMBER OF TEAM BY STAKEHOLDER
  - ROLLING 1 PG PROPOSALS THAT USE ARIA ($40-50K TO RAISE LOW ARL TO ARL4 FOR PROPOSING TO THE DISASTERS CALL + HIGHLY DESIRED FOR MANY PEOPLE ACROSS NASA CENTERS/AGENCIES)
- ESRI INTEGRATION OF NASA DATA INTO ARCGIS ONLINE ——
  - HIGHEST PRIORITY STAKEHOLDER COMMUNITY NEEDS
  - WHAT ARE DECISIONAL AND SCIENCE PRODUCTS
  - HIGHEST PRIORITY IS HIGH ARL PRODUCTS

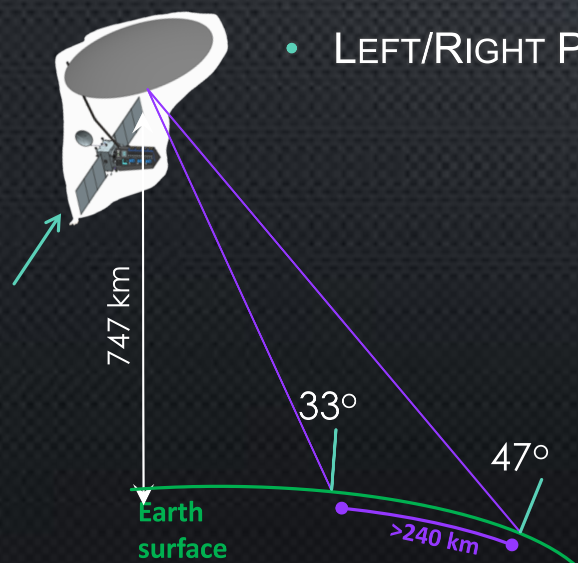
BACK-UP

Slide Courtesy of: Paul Rosen(JPL)

NISAR IMAGING AND ORBIT GEOMETRY

- WIDE SWATH IN ALL MODES FOR GLOBAL COVERAGE AT 12 DAY REPEAT (2-5 PASSES OVER A SITE DEPENDING UPON LATITUDE)
- DATA ACQUIRED ASCENDING AND DESCENDING
- LEFT/RIGHT POINTING CAPABILITY (RIGHT NOMINAL)

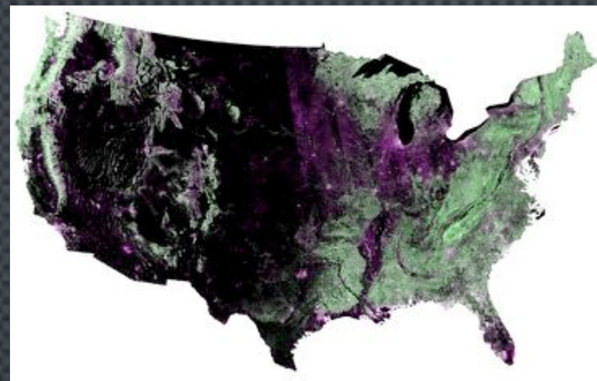




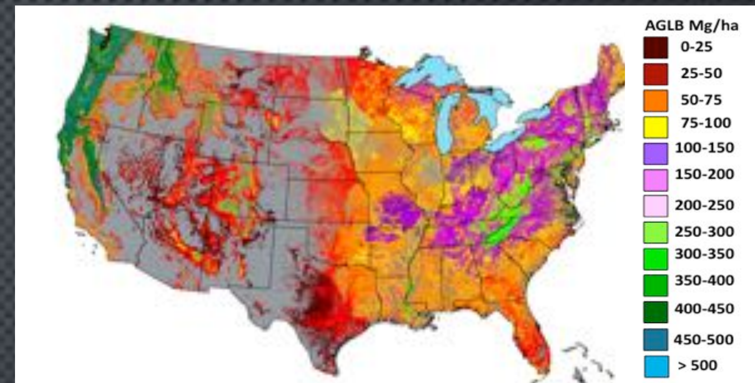
6 AM / 6 PM Orbit
98.5° inclination
Arctic Polar Hole: 87.5°R/77.5°L
Antarctic Polar Hole: 77.5°R/87.5°L

Observation Geometry

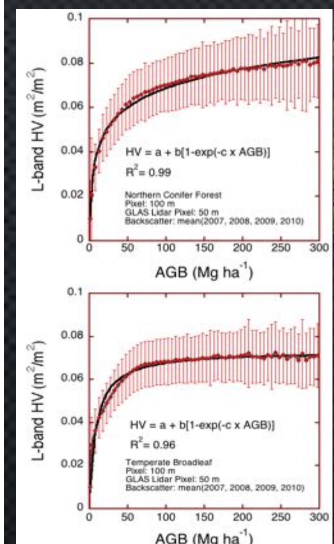
MAPPING GLOBAL FOREST BIOMASS



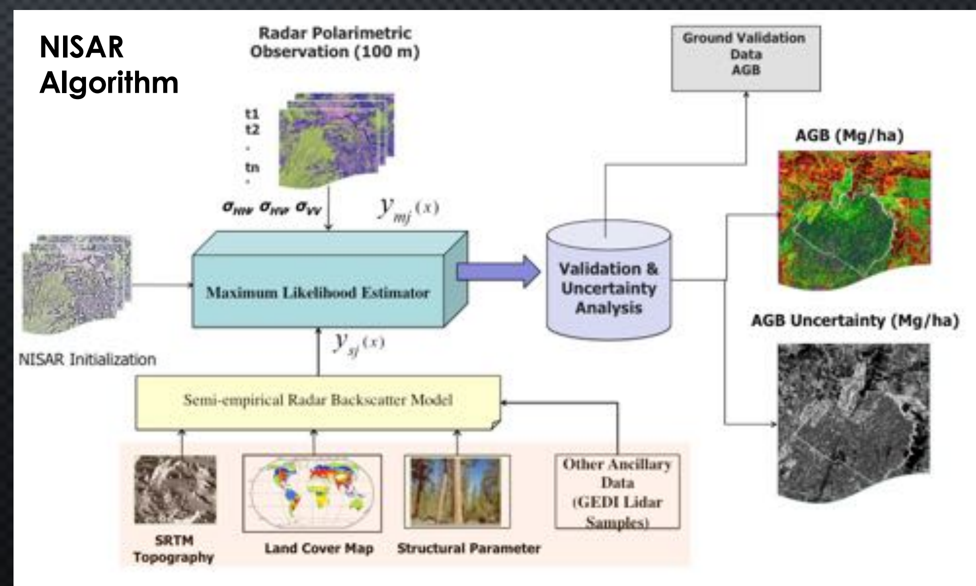
L-band HH and HV (ALOS PALSAR)



Biomass Derived from L-band SAR & National Inventory



NISAR 12-day global forest observation allows estimation of forest biomass at 1-ha with the low uncertainty for biomass < 100 Mg/ha



Slide Courtesy of:
Sassan Saatchi (JPL)

NISAR Observation of Global Vegetation Biomass

Geographical Regions of NISAR Forest Biomass Estimation

Regions with
AGB < 100 Mg/ha
50% of area

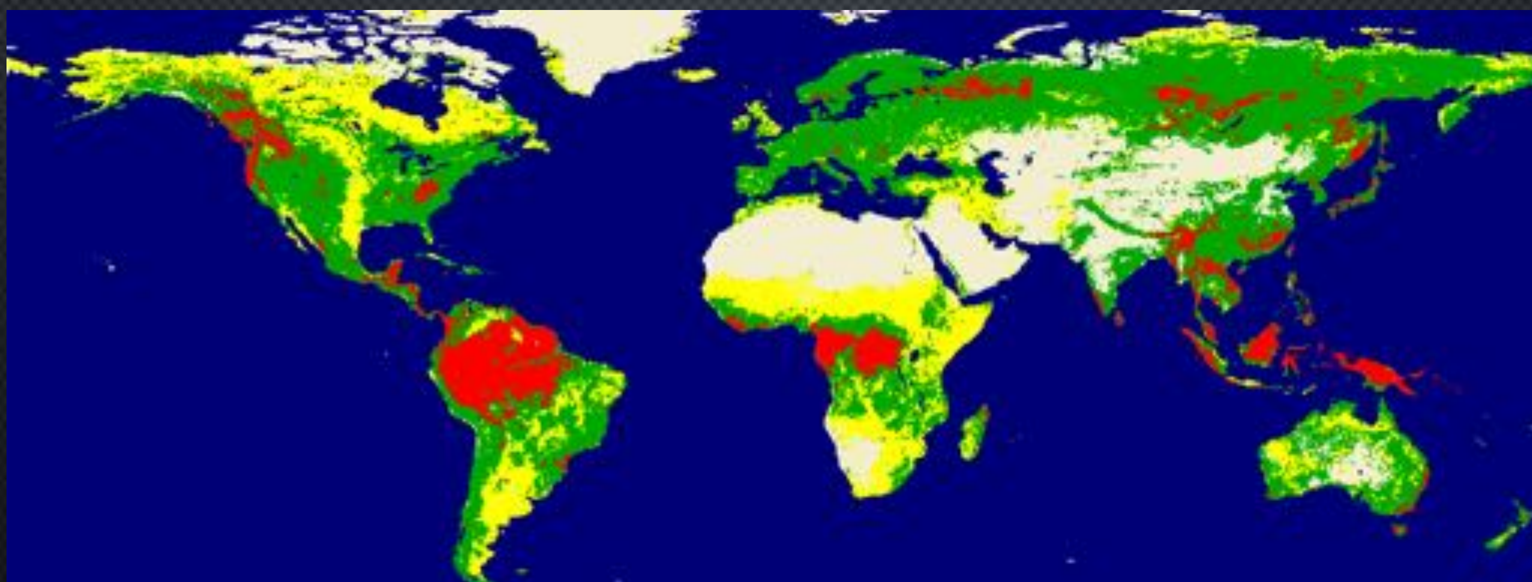
Regions with
AGB > 100 Mg/ha
50% of area

Regions with
AGB < 20 Mg/ha
50% of area

Regions with
No woody
vegetation

Open
Water

The global distribution of regions dominated by with woody biomass < 100 Mg/ha



Slide
Courtesy of:
Sassan
Saatchi (JPL)

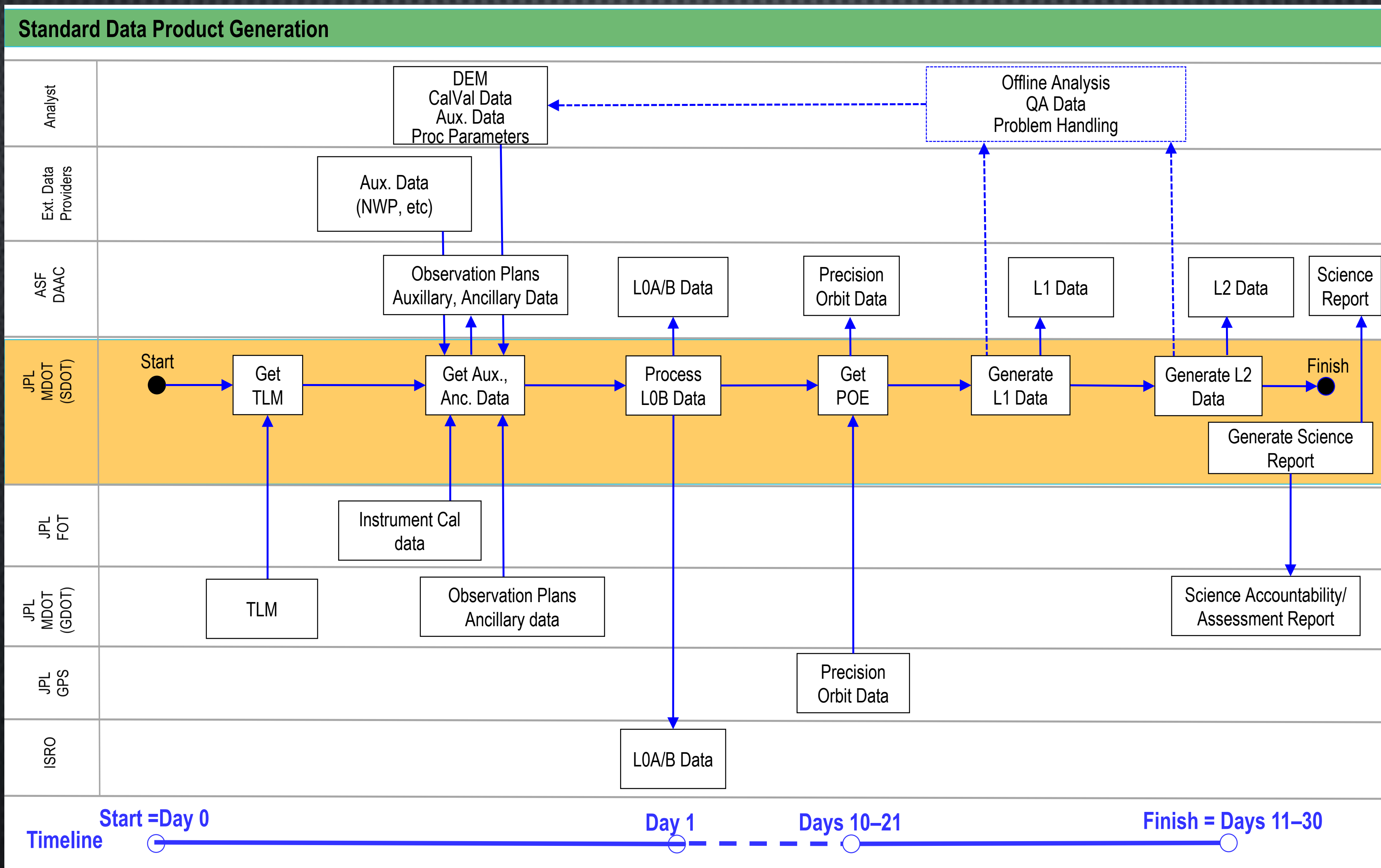
LATENCY

SLIDES COURTESY OF: PAUL ROSEN

Product	To DAAC
L0	
L0A (catalog incoming raw data)	3.25
L0B Radar Signal Data	3.25
L1	
Range-Doppler (i.e., Radar-Coordinate) Single-Look Complex (SLC)	30.33
Multi-Look Detected Browse (MLD)	0.54
L2 (all modes)	
Geocoded Single-Look Complex	30.33
Interferogram (nearest-time pair)	8.67
Amplitude Image (most recent image in InSAR pair)	4.33
Unwrapped Interferogram	4.33
Geocoded Amplitude Image (most recent image in InSAR pair)	4.33
Geocoded Unwrapped Interferogram	4.33
L2 Ecosystem (Quad)	
Polarimetric Image Channels	0.43
Polarimetric Coherence	0.43
Geocoded Polarimetric Image Channels	0.43
Geocoded Polarimetric Coherence	0.43
Total (TB)	**95.44**

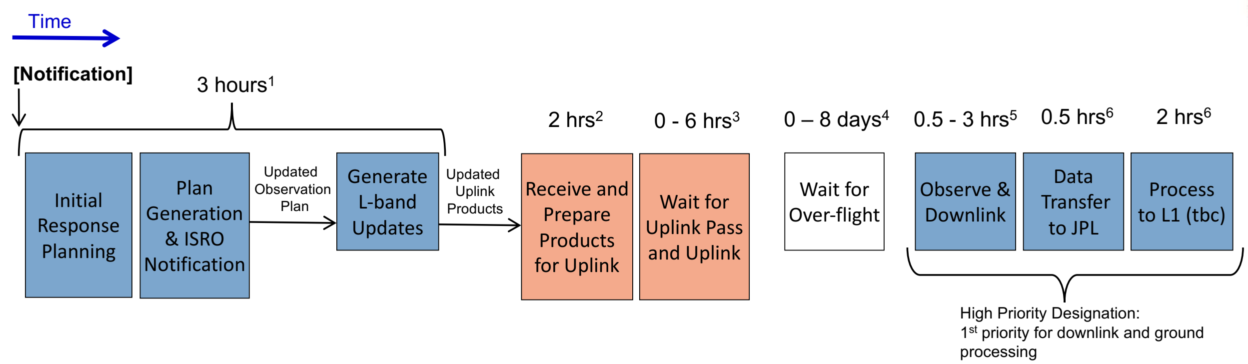
Summary *

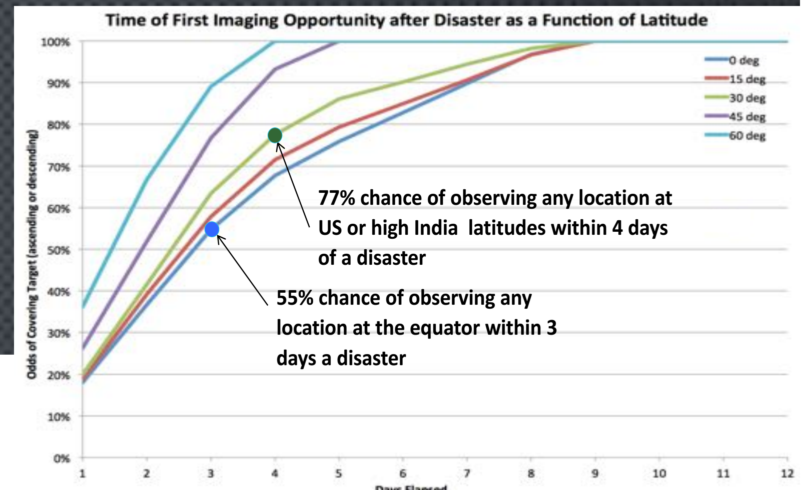
Prod Level	# of Prod Types	Volume (TB/day)
Level 0	2	6.5
Level 1	2	30.9
Level 2	10	58.1
Total	14	95.4


Standard Data Product Generation
Analyst
Ext. Data Providers
ASF DAAC
JPL MDOT (SDOT)
JPL FOT
JPL MDOT (GDOT)
JPL GPS
ISRO
DEM
CalVal Data
Aux. Data
Proc Parameters
Offline Analysis
QA Data
Problem Handling
Aux. Data
(NWP, etc)
Observation Plans
Auxillary, Ancillary Data
L0A/B Data
Precision
Orbit Data
L1 Data
L2 Data
Science
Report
Start
Get
TLM
Get Aux.,
Anc. Data
Process
L0B Data
Get
POE
Generate
L1 Data
Generate L2
Data
Finish
Generate Science
Report
Instrument Cal
data
TLM
Observation Plans
Ancillary data
Science Accountability/
Assessment Report
Precision
Orbit Data
L0A/B Data
Timeline
Start =Day 0
Day 1
Days 10–21
Finish = Days 11–30

Notional* Urgent Observations

*Urgent Response Plan is currently under development





Period	Requirement	Estimate
Time from Request to Scheduled Observation(s)	24 (TBR) hours	5 – 11 hours
Time from Observation to Product Delivery	9 (TBR) hours	3 to 5.5 hours
Wait for overflight		0 – 8 days

Notes
1. Only changes in observation priorities from "normal" to "urgent" are required. Only L-SAR changes are required.
2. Assumes 2 hour ISTRAC processing time.
3. Assume only one pass required for uplink.
4. Based on Monte-Carlo analysis showing >97% probability of over-flight at an arbitrary latitude within 8 days
5. Assumes an DTE coverage gap no longer than 3 hours
6. Assumes urgent response data is no more than 10% of daily volume

Responsibility Key:
ISRO
NASA/JPL

NISAR

Issues and Challenges of Near Real-Time Data Acquisition and Management

For missions:

- Mode requirements
- Mission operations
- Downlink costs
- Developing an urgent response play book to mark "urgent response" protocols
- Trade studies for understanding costs of meeting low latency
- Network costs

For applications communities:

- There is needed infrastructure for higher level processing for information products (that aren't usually in L1 & L2 requirements)
- Such infrastructure requires investment for development
- Longer time-series of information products that utilize the international synthetic aperture radar (SAR) constellation can help justify the investment for such development
- High priority NRT data products for SAR:
    - change detection
    - soil moisture
    - sea ice